

B-5-1-1 Road and Slope
Watershed Rehabilitation Project Summary Report

Unit 88-8

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Fee enhancement funding

Statement of Accomplishments

The 1988 fee enhancement funds were used to perform watershed rehabilitation work on Rodgers Peak. The rehabilitation work included the removal of the B-5-1-1 Road (3.2 miles), decompaction of numerous skid trails and the restoration of natural flow courses. The work was performed September 12 through 19, 1988.

The work was necessary to minimize erosion and to enhance revegetation processes on the areas which were impacted by timber harvesting operations in 1965 and 1966.

The fee enhancement funds payed for the rental of two pieces of heavy equipment with operators. Other expenses necessary to the project were paid for out of normal operating budgets.

Total Fee Enhancement Funds used: \$10,807.12

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INTRODUCTION

Watershed rehabilitation project Unit 88-8 encompassed the B-5-1-1 Road (3.2 miles) and hillslope above up to Rodgers Peak (205 acres). The purpose of the project was to minimize erosion and to enhance revegetation processes on the areas which were impacted by previous timber harvesting activities. Project work consisted of removing road fill from stream channels, decompacting road and skid trail surfaces, installing cross road drains and moving unstable road fill to more stable areas. The primary work was done by a Caterpillar D8H dozer and a Case 220 hydraulic excavator in September, 1988. Further work was done manually at various times during the summer of 1988.

SITE DESCRIPTION

LOCATION

The rehabilitation unit, 88-8, is located approximately 8 miles south of Orick, California in Redwood National Park (Figure 1). It is within sections 14, 13, 23 and 24 on the Rodgers Peak 7 1/2 minute series map. The B-5-1-1 Road encircles Rodgers Peak at a nearly uniform elevation of 2600 feet. The road crosses headwater channels of Bridge Creek and Tom McDonald Creek of the Redwood Creek Basin and Pitcher Creek on the south-west side which is a tributary to Big Lagoon. The road is located at the uppermost convex break in slope of Rodgers Peak.

LOGGING HISTORY

The area above the B-5-1-1 Road was clear cut timber harvested in 1965 and 1966 by tractor yarding methods. The B-5-1-1 Road was constructed during this time for use as a haul road.

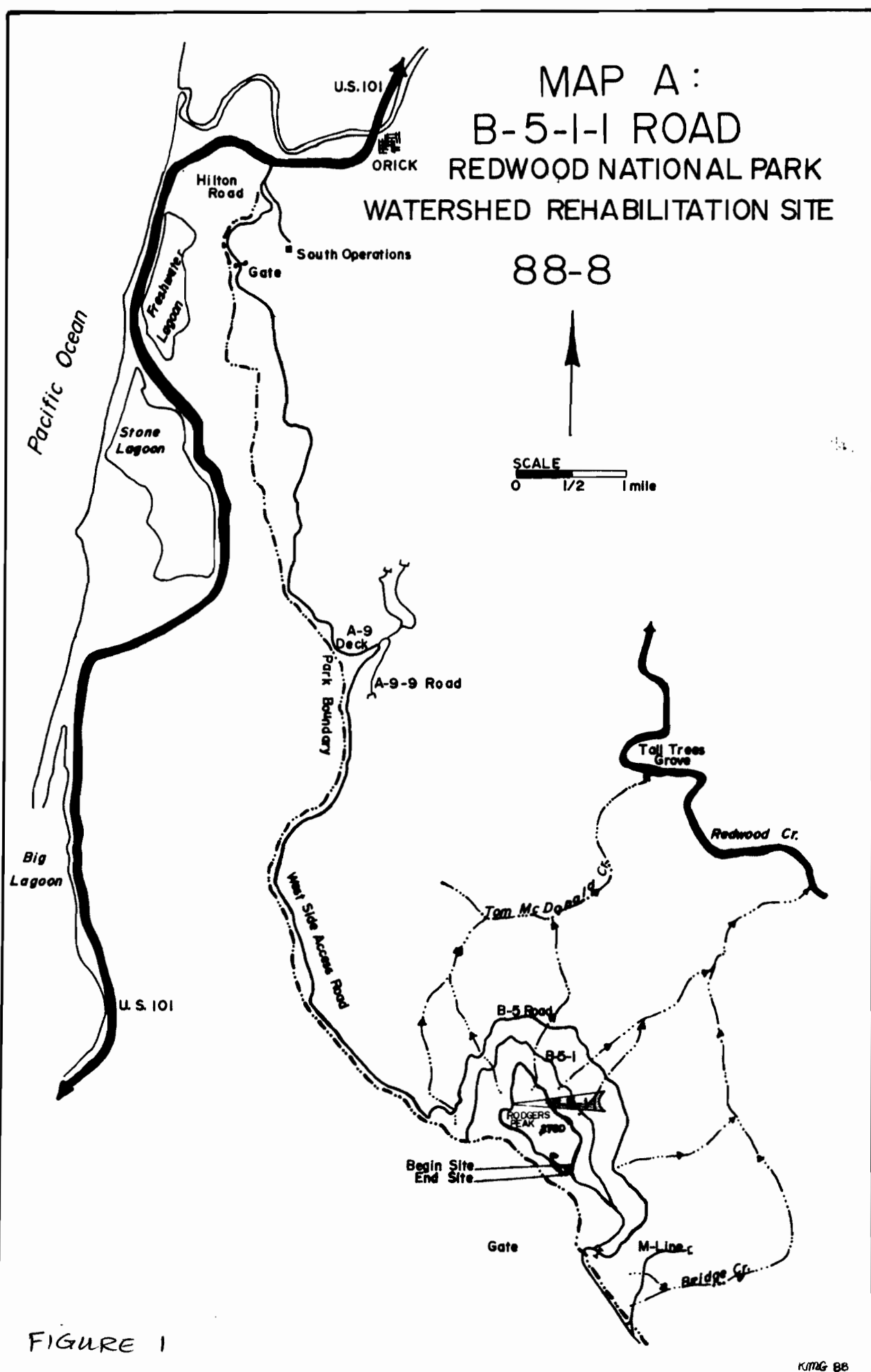
GEOMORPHOLOGY / GEOLOGY

Underfit, ephemeral stream channels occupy well incised broad valleys on the gentle upper slopes of Rodgers Peak. Only one of the eight headwater channels crossed by the B-5-1-1 road had surface flow in late September, 1988. Two short (about 30 ft) reaches of road have persistent ponded water at the inboard ditch. Both of these reaches are located on the south west side of Rodgers Peak in the Pitcher Creek Basin and are coincident with Devils Creek soil.

The area is underlain by Redwood Creek schist unit of Franciscan assemblage (Harden, et al, 1982).

SOILS

The soils on the B-5-1-1 Road are classified by Popenoe and Martin (1985) as Trailhead and variant, Fortyfour, Tectah, Coppercreek, Slidecreek, Ahpah and variant, Lacks Creek and variant, and moderately well drained Devils Creek. These soils are described, summarily, as well drained, rocky, and thin to moderately deep. The soils exhibit little erosion processes on the gentler slopes near the top of Rodgers Peak. Popenoe and Martin (1985) recommend to avoid long term scars and to restore damaged soils on Rodgers Peak due to the



relatively harsh climate and thin soils.

EROSION PROCESSES

Erosion on the upper slopes of Rodgers Peak is attributable mainly to fluvial processes. Sediment from the disturbed channels and hillslopes is transported downslope eventually impacting on Redwood Creek by increasing its sediment load. Concentrated runoff along skid trails and haul roads has resulted in gullying and rilling of the thin soils. Mass wasting processes are not active on the gentle topography and well drained clay rich soils, and there is little threat of a rapid catastrophic event supplying sediment to Redwood Creek.

The five haul road stream crossings on the B-5-1-1 road were all Humboldt style crossings composed of cut logs and fill. The crossings were in the initial stages of eroding and failing at the time of rehabilitation. Road fill between the logs of the Humboldt crossings was winnowing away over time and holes were developing at the road surface. The fines were being transported downstream at rates insufficient for risk to downstream resources. There was no potential for stream diversion at the haul road stream crossings due to the flat gradient of the haul road and the well incised low gradient valleys occupied by the underfit streams. Cut bank failures were minimal and restricted locally to dry ravel and rockfall failures deposited at the inboard edge of the road. The outboard edge of the road prism was very stable for nearly the entire length of the road. The exception is two localized short (30 feet) reaches on the south west side of the peak where the slopes are somewhat steeper immediately downslope of the road. In this area the perched road fill was offset vertically by 1 to 3 inch scarps.

Erosion due to skid trails consisted of concentration of surface flows resulting in rilling and gullying. The hillslope above the B-5-1-1 road was tractor yarded resulting in a maze of skid trails which ran both across the slope and down the slope. Many skid trails were located directly adjacent to, or along the center line of the stream valleys. This resulted in poorly defined flow courses operating as a diffused surface network or subsurface flow through the sediment and debris from past logging activity.

EROSION CONTROL WORK

The erosion control work is divided into four phases which are, evaluation, heavy equipment, labor intensive and documentation.

The evaluation phase includes: 1) mapping of geomorphic, hydrologic and land use disturbance features through air photo analysis and field mapping; 2) prescription and layout of erosion control work; surveying and calculation of volumes of prescribed treatments; peer review of proposed prescriptions; 3) establishment of permanent photo points for documentation of erosion control work and future changes resulting from revegetation and channel adjustments; and 4) scheduling the heavy equipment and labor intensive treatments.

The heavy equipment phase consists of accomplishing the prescribed treatments. The prescriptions accomplished by the heavy equipment on the B-5-1-1 Road included ripping the entire road surface and selected skid trails, installing cross road drains, excavating stream crossings and headwater swales, outsloping some reaches of the haul road, endhauling unstable fill from some reaches of the haul road to more stable areas and installing water bars on selected skid trails.

The labor intensive phase of the work included two treatment types; water bar installation and straw mulch delivery and spreading.

The documentation phase includes pre-heavy equipment and post-heavy equipment photo documentation, compilation and calculation of costs and report preparation.

The total cost for all phases of the erosion control work was \$22,592.85 and is summarized in Table 1.

EVALUATION PHASE

The evaluation phase for unit 88-8 was initiated in 1984 with air photo analysis and field mapping of the geomorphology and hydrology of Rodgers Peak roads and slopes. Field mapping continued intermittently through 1986. A contract was prepared in 1986 which prescribed treatments for the two roads encircling Rodgers Peak (the B-5-1-1 Road and the B-5-1 Road). The contract was ready to go out for bid, but was retracted due to budget constraints. This early portion of the evaluation phase was done by E. Wosika, M. Kenning, R. Mita, and M. Horns.

In 1988, the original contract was split resulting in two separate projects. A smaller contract for the lower road, the B-5-1 Road, was prepared and the work was completed in August, 1988 (Unit 88-5, supervised by M. Kenning). The B-5-1-1 Road, Unit 88-8, became scheduled to be completed at the end of the heavy equipment season as money became available from fee enhancement funding. In 1988, the evaluation phase continued at the B-5-1-1 Road with field confirmation of the prescribed treatments by the newly assigned geologist (D. Short), a peer review to include any updated techniques and understandings, establishment of photo points and scheduling of the heavy equipment and labor intensive phases. The 1988 evaluation phase began August 26 with field confirmation by D. Short, M. Kenning, and K. Griffin. The peer review included inputs from W. Weaver, R. Sonnevill, B. Belous, and A. Eck. Heavy equipment

Table 1
Rehab Unit 88-8
B-5-1-1 Road and Slope

Rehabilitation Work Cost Summary

	TOTAL COST	PERCENT OF TOTAL PROJECT COST (%)
<u>HEAVY EQUIPMENT</u>		
Primary Treatments From Table 2	\$8,439.68	35.3
Secondary Treatments Mulch - distribute straw From Table 2	\$ 30.00	0.1
Other Miscellaneous Costs From Table 8	\$3,432.22	14.4
Total Heavy Equipment Cost	<u>\$11,901.90</u>	<u>49.8</u>
<u>LABOR INTENSIVE WORK</u>		
Total Labor Intensive Cost From Table 9	\$ 3,641.10	15.2
<u>TECHNICAL WORK</u>		
Evaluation	\$ 5,838.12	24.5
Supervision	\$ 1,118.95	4.7
Documentation	\$ 1,393.00	5.8
Total Technical Work Cost	<u>\$ 8,350.07</u>	<u>35.0</u>
 TOTAL PROJECT COST	 \$23,893.07	 100.0

Table 2
Rehab Unit 88-8
B-5-1-1 Road and Slope

Heavy Equipment Work Costs Summary

PRIMARY TREATMENTS

Treatment	Worksite Quantity	Total Quantity	Total Cost \$	Average Cost Per Linear LF of Road	Average Unit Cost \$
Haul Road Crossings	5 sites	1940 yd ³	1,379.38 ¹	--	.71/yd ³
Deep Drains	3 sites	440 yd ³	626.18	--	1.42/yd ³
Exported Outslope	527 LF ²	Not Measured	2,138.32	4.06/LF	--
Outslope	2372 LF	Not Measured	1,755.98	0.74/LF	--
Ripping + Crossroad Drains	7422 LF	--	2,539.82	0.34/LF	--
Total Primary Treatments			<u>\$8,439.68</u>		

SECONDARY TREATMENTS

Mulch - distribute straw 30.00

OTHER MISCELLANEOUS COSTS

From Table 8 3,432.22

TOTAL HEAVY EQUIPMENT COST **\$11,901.90**

¹D8H caterpillar dozer with ripper teeth cost \$ 94.47/hr
220 Case excavator cost \$ 120.00/hr

²LF = Linear Feet of Road.

began work on September 12. Establishment of photo points was done immediately ahead of the heavy equipment by D. Short. Specific locations of the cross road drains and the layout and surveying of the deep drain at 107+00 was done by M. Kenning, D. Short, and K. Griffin as heavy equipment progressed along the road. The total cost for the evaluation phase is \$5,838.12. The cost was borne by four different fiscal budgets.

HEAVY EQUIPMENT PHASE

The Heavy equipment phase of Unit 88-8 began September 12, 1988 and was completed September 19, 1988. The work consisted of rehabilitating 3.2 miles of haul road, numerous landings and skid trails accounting for 205 acres of watershed area treated. Total heavy equipment costs for the site were \$11,901.90 (Table 2). Five stream crossings and three deep drains were excavated. Export outsloping (blade endhauling) was prescribed for 527 linear feet of road and 2372 linear feet of road was outslopped. Fifty one cross road drains were installed over 8075 feet of decompacted haul road. Two cross road drains and four water bars were installed on selected skid trails.

The heavy equipment work was done under hourly heavy equipment rental agreements. Two pieces of equipment were used on the site and included a Caterpillar D8H with ripper teeth and "U" blade rented from Twin Parks Lumber Company (\$94.47/hr) and operated by Bill Campbell, and a Case 220 Hydraulic Excavator with a 2 3/4 cu. yd. bucket rented and operated by Wendell Larkin (\$120.00/hr).

Haul Road Stream Crossing Excavations

Five haul road stream crossings were excavated along the B-5-1-1 Road. All five of the crossings were Humboldt crossings and were excavated down to original channel bottom below the "Humboldt" logs. Side banks were laid back to 50% or less and were graded to the remaining road bench at each side of the excavation. All of the crossings were dry at the time of excavating which contributed to the good excavation rates (111 to 175 yds³/equip-hr). The total cost for the haul road stream crossing excavations was \$1,379.38.

The haul road crossings were excavated as assurance against strictly local erosion and sediment transport. The stream crossings on the B-5-1-1 road did not pose a threat of torrenting down slope, and from a "purely erosional" standpoint the need for excavation could have been restricted to lesser volumes by excavating simply a ditch to convey winter flows. The decision to more thoroughly excavate the crossings was based on two lines of thought. 1) The equipment can maneuver much more easily in a broader more laid-back crossing resulting in higher production rates and thus a reduced unit cost. In contrast, by limiting the excavation to narrower widths with steeper side banks we actually increase equipment time by restricting mobility. Therefore, the costs for excavating a more layed back crossing (more volume) are similar to the costs for removing less volume within the narrower crossing. 2) The finished product of a thorough, complete stream crossing excavation is a channel / hillslope morphology which is similar to the surrounding natural morphology. This provides a more solidly beneficial foundation morphologically, hydrologically and aesthetically for landscape evolution.

The crossings were first dished down by the D8H dozer. The dozer then pushed the fill down the road, and spread it as an even blanket within 200 feet of the

centerline of the crossing. Approximately 90 percent of the total volume of the crossing was removed by the dozer. The hydraulic excavator then completed the excavation by pulling the remaining fill and organics from the bottom of the crossing. Final contouring of the flow course through the stream crossing was completed by the excavator.

Haul road stream crossing excavation rates averaged $146 \text{ yd}^3/\text{equip.-hr}$ and cost an average of $\$0.71/\text{yd}^3$ (Table 3). These represent good production rates in comparison to other rehabilitation projects in Redwood National Park.

Deep Drain Excavations

Three deep drains were excavated along the B-5-1-1 Road for a total cost of \$626.18. The deep drain excavation cost breakdown is shown in Table 4. The deep drains were essentially composed of clean fill (lacking organics), and all were dry at the time of excavation except for deep drain 65+60 which had flowing water fed by two springs upslope. The deep drains at 107+10 and 65+60 had lower excavation rates (53 and $93 \text{ yd}^3/\text{equip.-hr}$, respectively) than expected. This was due probably to the smaller working space afforded to the heavy equipment. At both of these deep drains the excavator did the majority of the excavating to minimize impacts on the surrounding vegetation and hillslope.

Exported Outsloping

Exported outsloping for the B-5-1-1 cost \$2,138.32 for 527 feet of treated road. The cost breakdown is shown in Table 5. All exported fill was blade endhauled (level pushes) to nearby (less than 400 feet) stable areas. Export outsloping was prescribed in reaches of the B-5-1-1 Road which were coincident with seeps and springs exposed in the cut banks (locally associated with Devils Creek Soil). The exportation of the road fill allows for the free discharge of the seeps and springs across the previous road alignment. Road fill is excavated down to as near as possible to original ground to inhibit the potential for gullying and to expose any remaining top soil buried during road construction.

Outsloping

Outsloping cost \$1,755.98 and accounts for treatment of 2372 linear feet of road. The costs are broken down and shown in Table 6. Outsloping was prescribed along reaches of the B-5-1-1 Road which had road fill perched above steep slopes on the western side of Rodgers Peak and where the inboard edge of the road and cut bank provided a stable fill site. In a few localized reaches, the outboard edge of the road prism was marked by 1 to 3 inch scarps, these areas were included within reaches of outsloping.

The outboard edge fillslope of the B-5-1-1 Road supported a dense stand of douglas fir and madrone which required a significant amount of excavator time to remove. This would normally cause a reduction in the excavation rates ($\text{yd}^3/\text{equip.-hr}$) compared with an outboard edge fillslope occupied by younger vegetation. However, I believe the increase in production afforded by the long reach of the Case 220 excavator and the large capacity of the bucket offset the increase in time spent removing the vegetation.

Cross Road Drains and Ripping

Stable reaches of the B-5-1-1 Road were prescribed to be ripped with cross road drains. Ripping of the road is to insure better infiltration of surface water

Table 3
Rehab Unit 88-8
B-5-1-1 Road and Slope

Haul Road Stream Crossing Excavation Costs Summary

Station	Excavated Volume Yd. ³	Total Cost \$	Unit Cost \$/yd ³	Equipment Hours		Mean Blade- Endhaul Distance Ft.	Excavation Rate Yd ³ /pc-hr
				DRH	220		
134+29	350	195.32 ¹	0.56	1.75	0.25	180	175
120+50	230	148.09	0.64	1.25	0.25	100	153
114+12	770	523.41	0.68	3.00	2.00	150	154
100+00	250	250.85	1.00	0.75	1.50	200	111
57+35	340	261.71	0.77	1.50	1.00	125	136
AVERAGE							
TOTAL	1940	\$1,379.38	\$0.71	8.25	5.00	--	146

¹D8H caterpillar dozer cost \$94.47/hr.
220 Case excavator cost \$120.00/hr.

Notes:

1. Averages are volume weighted.
2. Excavation rate is volume excavated divided by the total combined number of equipment hours.
3. Volumes are pre-excavation surveyed volumes, due to time constraints stream crossings were not surveyed after excavation.
4. All material was pushed along a level road.

Rehab Unit 88-8
B-5-1-1 Road and Slope
Table 4

Deep Drain Excavation Costs Summary

Station	Excavated Volume Yd. ³	Total Cost \$	Unit Cost \$/yd. ³	Equipment Hours		Mean Blade- Endhaul Distance Ft.	Excavated Rate Yd ³ /pc-hr
				D8H	220		
107+10	185	388.09	2.10	1.25	2.25	80	53
65+60	70	83.62	1.19	0.25	0.50	125	93
19+87	185	154.47	0.83	1.00	0.50	125	123
AVERAGE OR TOTAL	440	\$ 626.18	1.42	2.50	3.25		77

¹D8H caterpillar dozer cost \$94.47/hr
220 Case excavator cost \$120.00/hr

Notes:

1. Averages are volume weighted.
2. Excavation rate is volume excavated divided by the total combined number of equipment hours.

Table 5
Rehab Unit 88-8
B-5-1-1 Road and slope

Exported (Blade Endhauling) Outsloping Costs Summary

Station	Linear Feet of Road (LF) ¹	Total Cost \$	Unit Cost \$/LF	Equipment Hours	
				hr.	
				D8R	EXC
116+00	145	471.71	3.25	1.50	2.75
104+00	27	130.85	4.85	0.75	0.50
27+85	213	915.97	4.30	5.25	3.50
14+40	142	619.79	4.36	2.75	3.00
AVERAGE OR TOTAL	527	\$2,138.32	4.06	10.25	9.75

¹LF=Linear Feet of road.

Notes:

Averages are volume weighted.

All material was pushed along a level road.

No volume surveys done due to time constraints.

Average road width approximately 18 - 25 feet.

All pushes were less than 200 feet.

Table 6
Rehab Unit 88-8
B-5-1-1 Road

Outsloping Costs Summary

Station	Linear Feet of Road (LF) ¹	Total Cost \$	Cost/ Linear (LF)	Equipment Hours	
				D8H	220
106+70	50	77.23	1.54	0.50	0.25
44+50	1150	697.03	0.60	3.25	3.25
28+85	100	203.62	2.03	0.25	1.50
24+20	208	137.24	0.66	0.50	0.75
21+61	161	107.24	0.67	0.50	0.50
19+65	361	413.62	1.15	0.25	0.75
9+18	342	120.00	0.35	0.00	1.00
AVERAGE OR TOTAL	2372	\$1,755.98	\$0.74	5.25	8.00

¹LF=Linear Feet of road.

Notes:

Averages are volume weighted.

No volume surveys done due to time constraints.

and to enhance revegetation processes. Cross road drains were prescribed along 7422 linear feet of the B-5-1-1 Road. Drains were located with maximum spacing of one every 250 feet, and averaged about one every 150 feet. Drain lengths were not measured, but are estimated at about 30 feet each (average). Locations were prescribed to insure free drainage from the inboard edge of remaining road benches. Discharge from the drains is directed to less erodible, original hillslope.

Many skid trails were also ripped to enhance revegetation. Only those skid trails which were unvegetated and easily assessable from the B-5-1-1 Road were ripped. On the sloping skid trails, berms were placed across the "furrows" from the ripping to intercept concentrated flows and inhibit gullyng.

Total cost for cross road drains and ripping are summarized in Table 7.

Miscellaneous Costs

Miscellaneous costs created by the heavy equipment are summarized in Table 8 and total \$3,432.22. Miscellaneous costs are the costs paid to the heavy equipment which are not accountable to site specific erosion control work.

LABOR INTENSIVE PHASE

The labor intensive phase is composed of two separate projects: 1) the construction of water bars on skid trails and, 2) the delivery and spreading of straw mulch on completed work sites. The labor intensive work is summarized in Table 9 and totals \$3,641.10. Two water bars were constructed on a skid trail downslope of the B-5-1-1 road on the southwest side of the peak to prevent diversion. The water bars were constructed by Youth Conservation Corps crews because revegetation was well established and didn't warrent access to heavy equipment. The work was done August 17, 1988, supervised by K. Griffin. The crew used hand tools and spent 4 hours to complete both water bars. Straw mulch delivery and spreading began September 13 and continued intermittantly along with heavy equipment as treatments were completed. Straw mulch was spread (at approximately 6000 lbs/acre) at all stream crossings, deep drains and exported outslope reaches to prevent surface erosion and aid revegetation.

DOCUMENTATION PHASE

The documentation phase was completed by D. Short, K. Griffin, M. Kenning and L. Johnson in December, 1988. This phase of Unit 88-8 cost \$1,393.00.

DISCUSSION

The rehabilitation work on the B-5-1-1 Road and skid trails on Rodgers Peak was performed smoothly and efficiently. The final product should provide a good foundation for healthy revegetation and will reduce potential erosion and sediment supply to down stream resources.

The total heavy equipment costs for the project were \$11,901.90, far less than the original estimate of \$20,000.00 for the project in 1986. This is probably due to utilizing more efficient and cost effective equipment than were thought to be available in 1986. This is especially evident in the use of the Case 220 excavator with the 2 3/4 yd bucket with 48 feet reach as opposed to one yard

Table 7
Rehab Unit 88-8
B-5-1-1 Road

Cross Road Drains and Ripping Costs Summary

ROAD REACH	D8H HRS	220 HRS	TOTAL COST	REACH LENGTH (LF) ¹	No. of XRD'S	XRD'S / LF	COST /XRD	COST / LF	RIP LF/HR	No. of XRD/HR
<u>D8H RIPPING ONLY</u>										
158+70 - 136+75	1.25	--	\$118.09	2195	--	--	--	0.054	1756	--
99+50 - 73+00	2.75	--	\$259.79	2650	--	--	--	0.098	963	--
Total or Average	4.00	--	\$377.88	4845	--	--	--	0.078	1211	--
<u>220 XRD'S ONLY</u>										
158+70 - 136+75	--	2.50	\$300.00	2195	12	1/183	25.00	--	--	4.8
99+50 - 73+00	--	2.50	\$300.00	2650	16	1/166	18.75	--	--	6.4
Total or Average	--	5.00	\$600.00	4845	28	1/173	21.43	--	--	5.6
<u>D8H AND 220 WORKING TOGETHER</u>										
132+30 - 122+00	1.75	1.25	\$315.32	1030	7	1/105	45.05	0.306	--	2.3
44+50 - 33+00	1.00	0.75	\$184.47	1050	10	1/105	16.09	0.176	--	5.7
Total or Average	2.75	2.00	\$499.79	2080	17	1/105	29.40	0.482	--	3.8
SKID TRAIL ³	2.00	0.75	\$278.94	--	--	--	--	--	--	--
MISC. ²	5.75	2.00	\$663.20	497	?	--	--	--	--	--
TOTALS	14.50	9.75	\$2,539.82	7422	?	--	--	--	--	--

¹LF = Linear Feet of Road

²Misc. includes reaches of road which were done while the geologist wasn't looking, and therefore documentation was lacking.

³Skid trail ripping and cross road drains were not measured.

Notes:

No surveys were done due to time constraints.

Table 8
Rehab Unit 88-8
B-5-1-1 Road

Other Miscellaneous Heavy Equipment Rehabilitation Costs Summary

Task	Task Cost \$	Equipment Hours hr.		% of Total Heavy Equipment Cost
		D8H	220	
Mobilization	428.94	2.00	2.00	3.97
Access	424.46	1.00	2.75	3.93
Down time paid	60.00	0.00	0.50	0.56
Breaks	506.18	2.50	2.25	4.68
Discussion	894.26	3.75	4.25	8.27
Brushing	23.62	0.25	0.00	0.22
Total hours		(9.50)	(11.75)	
Move in/out	1,094.75	\$ 679.75	\$ 415.00	
TOTAL COSTS:	\$3,432.22	\$1,577.22	\$1,855.00	21.63%

Notes:

Lowboy costs would have been higher, except that the equipment was already in the park and costs were split with other rehabilitation site (88-9).

Table 9
Rehab Unit 88-8
B-5-1-1 Road and Slopes

Labor Intensive Phase Costs Summary

	Number of Bales	RNP		RUI		TOTAL Cost \$	Cost per Bale \$
		Person Hours	Cost \$	Person Hours	Cost \$		
STRAW MULCH							
Materials	130	--	--	--	--	406.90	3.13
Loading	130	16	181.23	20	180.36	361.59	2.78
Distribution	130	50	547.50	110	901.98	1449.48	11.15
Spreading	130	62	711.87	60	505.82	1217.69	9.37
TOTAL		128	\$1,440.60	190	\$1,588.16	\$3,435.66	\$26.43

	Quantity	RNP		YCC		TOTAL Cost \$
		Person Hours	Cost \$	Person Hours	Cost \$	
WATER BARS	2	8	69.44	32	\$136.00	\$205.44

LABOR INTENSIVE PHASE TOTAL	\$3,641.10
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Loading is the cost of loading the straw at South Operations Center onto Redwood National Park's flat bed truck. At some rehabilitation sites this cost could be eliminated by having the straw delivered directly to the rehabilitation site rather than to South Operations Center.

buckets with shorter reaches in use in 1986.

The two equipment operators (Wendell Larkin and Bill Campbell) are well experienced in rehabilitation operations and were continually working toward providing the most efficient approach to each individual task. The supervising geologist on the site had minimal experience in heavy equipment rehabilitation work and gained an enormous repertoire of rehabilitation approaches from the cooperative operators.

The labor intensive phase of the project proved to be expensive at \$3,641.10. This is one third of the cost for all of the heavy equipment phase. Straw mulch accounted for the bulk of the labor intensive phase costs. This probably occurred by way of trying to "keep busy" the Redwoods United, Inc. work crews. Work crews with as many as 10 persons were dispatched to do the work that 4 to 5 persons can do much more efficiently. The cost to do the work also includes the time to travel to the project site from Orick and the time to walk in along the rehabilitated road to spread straw. It is much more cost effective to pay 5 persons to travel and walk in to spread straw than to pay 10 persons to do the same. I recommend that, in the future, we limit the straw spreading projects to a crew size proportionate to the size of the project.

REFERENCES

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Unit: 88-8 Date: 9-13-88. B-5-1-1, PP7. DAS



Unit: 88-8 Date: 11-30-88. B-5-1-1, PP7. DAS



Unit: 88-8 Date: 9-13-88. B-5-1-1, PP7.5 DAS



Unit: 88-8 Date: 11-30-88. B-5-1-1, PP7.5 DAS



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Unit: 88-8 Date: 11-30-88. B-5-1-1, PP12B. DAS